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APPLICATION OF BIOURINE ON GROWTH AND YIELD OF SHALLOT FERTILIZED WITH INORGANIC AND ORGANIC FERTILIZER IN BATU, EAST JAVA

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ABSTRACT

The experiment was done in order to know the influence of Biourine on growth and yield of shallot fertilized with organic and inorganic fertilizers in Batu, East Java, 900 m asl, 24-27 ^{0}C, Andosol soil, from May to July 2014. A Factorial Randomized Block Design was used in arranging treatments i.e. applied of Biourine (with and without Biourine) and applied of organic-inorganic fertilizer. The results showed that the application of Biourine and inorganic fertilizer increased growth and yield of shallot var. Philippines. Shallot var. Philliphines applicated with Biourine 1000 L ha^{-1} and 100 kg N ha^{-1} (ZA); 50 kg P_2O_5 ha^{-1} (SP36) and 70 kg K_2O ha^{-1} (KCl) showed the highest bulb yield (1,932.2 kg m^{-2}) and the lowest showed the treatment of 5 t ha^{-1} organic fertilizer without Biourine with yield of 1,285.7 kg m^{-2} or increased 50.3%.

Keywords: Biourine; organic-inorganic fertilizer; shallot var. Philippines

INTRODUCTION

Shallot production in Indonesia achieved 1,227,838 tonnes from harvested area of 119,966 ha (10.23 t ha^{-1}) (Statistics Indonesia, 2014). One of several shallots cultivated in Indonesia is Philippines variety. This variety had been released by Ministry of Agriculture No. 66 Kpts/TP.2402/2002, with the description such as, flowering at 50 DAP (days after planting), 60% of leaves are softly at 60 DAP, plant height 34-45 cm, 9-18 plants per hill, 40-75 leaves per hill, potential of production 17.6 t ha^{-1} (Putrasamedja and Suwandi, 1996).

Recently some farmers used cow biourine in improving growth of shallot and increasing the bulb yield. By using Biourine the farmers obtained the bulb yield of shallot (an average of 20 t ha^{-1}) better than without Biourine (an average 10 t ha^{-1}) (Hadi, 2005; Santosa, 2006).

Santosa *et al.,* (2013), reported that shallot of Philippines cvs planted in dry season and applicated with Biourine (1 L of cow urine mixed with 5 kg cow faeces and diluted 50 L water than fermented at least 1 weeks, and this formula able to use for 500 m^2) and inorganic fertilizer (100 kg N ha^{-1} (ZA), 50 kg P_2O_5 ha^{-1} (SP36) and 75 kg K_2O ha^{-1} (KCl) resulted high yield i.e. 148,9 g per hill or equal 2,382 g m^{-2} (23.82 t ha^{-1}).

Jayathilake *et al*., (2003), Akoun (2005), Ali *et al.,* (2007) and Yoldas *et al.,* (2011), showed that the interaction of organic and inorganic fertilizers increased the diameter of the shallot bulbs, furthermore, improved growth and bulb quality gave impact on bulb yield enhancement. Singh *et al.,* (1997), Kumar *et al.,* (2001), Sharma *et al.,* (2003), Coolong *et al.,* (2005) and Sumarni *et al.,* (2012) reported that the application of inorganic fertilizer N, P and K with the addition of organic fertilizers increased nutrient uptake and yield of shallot.

Santosa and Suryanto (2014), indicated that shallot planted in wet season caused plant age of shallot shorter and harvesting time faster (56 DAP) because the leaves of shallot became soft and damaged than the yield was relatively lower (an average of 11 t ha^{-1}). Based on this growth and yield of shallot, it can be stated that yield of shallot were varied depend on planting time (season), farmer's cultivation methods, soil type, application of kinds and dosages of fertilizers and methods of shallot husbandry and than for this reason the research was done in order to know the influence of Biourine applied with organic and anorganic fertilizer on growth and yield of shallot var. Philippines cvs.

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MATERIALS AND METHODS

The experiment was done in order to know the influence of Biourine applied with organic-anorganic fertilizer on growth and yield of shallot (Philippines cvs.) planted in Batu, East Java, 900 m asl, 24-27 ^{0}C, Andosol soil, dry season (from May to July, 2014).

The field experiment was carried out by using Factorial Randomized Block Design with three replications. The first factor was Biourine application which consisted of two levels, i.e. without (A1) and with Biourine 1000 L ha^{-1} (A2). The second factor was application of organic-inorganic fertilizer, i.e. 100% inorganic fertilizers (100 kg N ha^{-1} (ZA), 50 kg P_2O_5 ha^{-1} (SP36) and 75 kg K_2O ha^{-1} (KCl) (B1); 50% inorganic fertilizers (50 kg N ha^{-1} (ZA), 25 kg P2O5 ha^{-1} (SP36) and 37.5 kg K_2O ha^{-1} (KCl) (B2); 100% organic fertilizers (10 t ha^{-1} cow manure), and (4) 50% organic fertilizers (5 t ha^{-1} cow manure).

The observed variables included growth (i.e. plant height, leaves number, leaf area per leaf and leaf area index (LAI)), yield components (i.e. number of bulbs and bulb weights), and changes of soil chemical properties.

The data was analyzed with ANOVA followed by LSD 5% (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Growth Response of Shallot to Application of Biourine Combined with Organic-Inorganic Fertilizer

The growth variables such as plants height, leaves number, leaf area, and leaf area index (LAI) were presented in Table 1.

Application of Biourine combined with inorganic fertilizer increased plants height, leaf numbers, leaf areas, and leaf area index (LAI) of shallot Philippines. The application of Biourine 1000 L ha^{-1} combined with 100 kg N ha^{-1} (ZA), 50 kg P_2O_5 ha^{-1} (SP36) and 75 kg K_2O ha^{-1} (KCl) resulted the highest plant height, leaves numbers, leaf area, and leaf area index (LAI) at 56 days after planting, and the lowest showed by application of 5 t ha^{-1} organic fertilizer (cow manure) without Biourine.

Plant height of shallot increased on average of 4-26%, leaves number on average of (-3) - 28%, leaf area per leaf from 11-13% and leaf area index (18-21%). Application of Biourine combined with organic-inorganic fertilizer (cow manure 10 t ha^{-1}) resulted higher response than others that means this treatments (Biourine application) stimulated the growth of shallot.

Table 1. Plants height, leaves number, leaf area and leaf area index (LAI) of shallot affected by Biourine and organic-inorganic fertilizer

No.	Treatments	Plants height (cm)	Leaves number (sheet hill^{-1})	Leaf area (cm^2 leaf^{-1})	Leaf Area Index (LAI)
1	A1B1	51.4 ab	54.9 b	31.1 b	3.46 b
2	A2B1	53.6 a	58.7 a	35.3 a	4.39 a
3	A1B2	49.5 ab	46.2 d	28.2 c	2.61 d
4	A2B2	48.9 b	50.6 c	34.1 a	3.35 b
5	A1B3	49.5 b	44.5 de	35.1 a	2.99 c
6	A2B3	52.6 a	52.9 bc	36.1 a	4.11 a
7	A1B4	45.9 c	43.4 e	27.8 c	2.43 d
8	A2B4	47.5 bc	47.1 cd	31.8 b	2.91 c
	LSD 5%	2.2	2.1	2.1	0.21
	CV (%)	10.3	9.3	15.1	14.4

Remarks: DAP: days after planting; A1(without Biourine); A2 (with Biourine); B1 (Inorganic fertilizers consisted of 100 kg N ha^{-1} (ZA), 50 kg P_2O_5 ha^{-1} (SP36) and 75 kg K_2O ha^{-1} (KCl)); B2 (Inorganic fertilizers consisted of 50 kg N ha^{-1} (ZA), 25 kg P_2O_5 ha^{-1} (SP36) and 37.5 kg K_2O ha^{-1} (KCl)); B3 (Organic fertilizers/cow manure 10 t ha^{-1}), and B4 (Organic fertilizers/cow manure 5 t ha^{-1}). The numbers in a column having same letter(s) did not significantly different at LSD 5%.

Application of Biourine and organic fertilizer (cow manure 10 t ha^{-1}) resulted higher response than others. According to Ibrahim (2010), the addition of fertilizers could increase the number of shallot leaves of 6-11 sheets with an average of one leaf per week. Abdissa *et al.,* (2011) stated that the proper application of N fertilizer increased plant height and leaves number approximately 11.5% and 8% respectively. Application of organic fertilizer increased root length and dry weight of root in the rhizosphere conditions by increasing the population of microorganisms (Shaheen *et al*., 2007; Ouda and Mahadeen, 2008).

Application of inorganic fertilizer increased the nutrient content in the soil, however this application may the longer the nutrients in the soil decreasing, due to N (ZA) fertilizer was faster released but also faster lossed in soil, so the deficiency must be added from the outside trough fertilization (Lasmini *et al.,* 2015) . Deficiency of N, P, K at the growth stage reduced root fresh weight and defficiency of organic fertilizer also reduced leaf number and leaf area for each leaf (Niedziela *et al.,* 2008; Woldetsadik and Workneh, 2010).

Shallot Yield Response to Application of Biourine and Organic-Inorganic Fertilizer

Yield of shallot at harvest presented by parameters of bulb numbers and bulb weight which were presented in Table 2. The yield of shallot increased due to the application of Biourine combined with organic-inorganic fertilizer. This was supporting the results of Jayathilake *et al*., (2003), Akoun (2005), Ali *et al.,* (2007); Woldetsadik and Workneh (2010) and Yoldas *et al.,* (2011) that the interaction of organic and inorganic fertilizer increased the diameters of the bulbs, improved growth and bulb quality gave impact on bulb yield enhancement.

Singh *et al*., (1997), Kumar *et al.,* (2001), Sharma *et al.,* (2003), Coolong *et al.,* (2005) and Sumarni *et al.,* (2012) found that the application of inorganic fertilizer N, P and K with the addition of organic fertilizer increased nutrient uptake and yield of shallot to 30%.

Application of inorganic fertilizer 100 kg N ha^{-1} (ZA), 50 kg P_2O_5 ha^{-1} (SP36) and 75 kg K_2O ha^{-1} (KCl), also increased the nutrient content in the soil. This application allowed the longer the nutrients in the soil, and supported the growh and yield of shallot. Reverselly, the soil nutrient was decreased, due to N (ZA) fertilizer that was faster released but also faster lossed in soil, so the deficiency of N must be added from the outside through fertilization (Lasmini *et al.,* 2015). Deficiency of N, P, K at the growth stage could lead to reduced root fresh weight (Niedziela *et al*., 2008), whereas defficiency of organic fertilizer reduced leaf number and leaf area for each leaf. Ibrahim (2010), showed that the addition of fertilizers could increase the number of shallot leaves of 6-11 sheets with an average of one leaf per week.

Table 2. Bulb numbers and bulb weight of shallot affected by Biourine and organic-inorganic fertilizer

Treatments	Bulb numbers/hill	Bulb weight		
		g/bulb	g/hill	g m^{-2}
A1B1	15.6 ab	7.8	97.3 c	1577.5 c
A2B1	18.1 a	7.9	114.3 a	1860.2 a
A1B2	12.4 ab	7.1	70.4 g	1156.9 g
A2B2	14.8 ab	7.4	87.6 e	1441.8 d
A1B3	13.2 b	8.0	84.4 f	1341.6 e
A2B3	15.9 ab	8.1	103.0 b	1688.5 bc
A1B4	11.9 b	7.6	72.3 g	1257.6 f
A2B4	14.7 ab	7.8	91.7 d	1487.6 d
LSD 5%	4.4	ns	2.9	74.2
CV (%)	7.1	24.2	7.4	11.7
Average	14.5	7.7	90.1	1476.4

Remarks: DAP: days after planting; A1 (without Biourine); A2 (with Biourine); B1 (Inorganic fertilizers consisted of 100 kg N ha^{-1} (ZA), 50 kg P_2O_5 ha^{-1} (SP36) and 75 kg K_2O ha^{-1} (KCl)); B2 (Inorganic fertilizers consisted of 50 kg N ha^{-1} (ZA), 25 kg P_2O_5 ha^{-1} (SP36) and 37.5 kg K_2O ha^{-1} (KCl)); B3 (Organic fertilizers/cow manure 10 t ha^{-1}) and B4 (Organic fertilizers/cow manure 5 t ha^{-1}). The numbers in a column having same letter(s) did not significantly different at LSD 5%.

Abdissa *et al.,* (2011), also indicated that the proper application of N fertilizer increased plant height and leaves number approximately 11.5% and 8%. Furthermore, organic fertilizer increased root length and dry weight of root in the rhizosphere conditions by increasing the population of microorganisms (Shaheen *et al*., 2007; Ouda and Mahadeen, 2008).

Application of Biourine Combined with Organic-anorganic Fertilizer Caused the Changes in Chemical Soil Properties

Chemical soil contents analysis showed changes in chemical soil properties such as soil pH, N, P and K and the percentages of increasing in soil status (Table 3). Soil pH before the experiment was 6.07 and after application of Biourine (pH 6.74) for all treatments decreased. Soil pH 6.31-6.47 means pH soil applicated Biourines combined fertilizers was acid, and it would influence the availability of soil nutrients (Brady, 1984).

N soil before planting was 0.104% and Biourine was 0.84%, and status N soil after treated Biourine combined fertilizers decreased (0.11-0.12% N) means the status N in soil was low. C/N soil before planting 14.04 and Biourine 0.06, influenced C/N soil after shallot harvest.

Status of Phosphate was represented by P_2O_5 (ppm) Olsen in soil before experiment was very high (46.5) and Biourine as well (46), and status of this nutrient after shallot harvest was still very high, it means in this soil, there was sufficient enough of P and it did not require P fertilizer.

Status of Potassium in soil (before shallot planting and application of Biourine and fertilizer was higher (1.14) than status K in Biourine (0.81). The application of Biourine and fertilizer, as well as the planting of shallot var. Philippines decreased the content of potassium in soil (0.41-0.86), however the status in soil was medium.

Application of Biourine and organic-inorganic fertilizer decreased N, P and K content in soil, moreover, status of potassium in this soil decreased but nutrient status was still higher. It means that K content in this soil was sufficient. Shaheen *et al.,* (2007) and Woldetsadik and Workneh (2010) reported that cattle manure was good for shallot cultivation due to it's content of N, P and K that was relatively high 4.1 N g kg^{-1}, 6.64 P g kg^{-1} and 0.39 K g kg^{-1} and it increased shallot growth and yield. These result were also supported by Santosa *et al.,* (2013), who stated that shallot var. Philippines planted in dry season, the application Biourine and organic-inorganic fertilizer increased growth and yield of shallot (23.82 t ha^{-1}).

Table 3. Status of soil chemical properties before and after treated by combination of Biourine and organic-inorganic fertilizers

Materials	pH sol. H_2O	%C	%N	C/N	P_2O_5 (ppm) Olsen	K (me) As Ac pH 7.1 N
Soil before experiment	6.07	1.46	0.104	14.04	46.5	1.14
Biourine	6.74	0.05	0.84	0.06	46	0.81
A1B1	6.23	1.44	0.12	12.02	25	0.86
A2B1	6.31	1.56	0.12	13.01	27	0.68
A1B2	6.32	1.32	0.11	11.32	24	0.44
A2B2	6.41	1.37	0.11	12.45	25	0.43
A1B3	6.47	1.62	0.12	12.01	26	0.57
A2B3	6.31	1.36	0.12	11.33	26	0.46
A1B4	6.31	1.32	0.11	12.01	23	0.41
A2B4	6.44	1.36	0.11	12.36	24	0.42

Remarks: DAP: days after planting; A1(without Biourine); A2 (with Biourine) ; B1 (Inorganic fertilizers consisted of 100 kg N ha^{-1} (ZA), 50 kg P_2O_5 ha^{-1} (SP36) and 75 kg K_2O ha^{-1} (KCl)); B2 (Inorganic fertilizers consisted of 50 kg N ha^{-1} (ZA), 25 P_2O_5 ha^{-1} (SP36) and 37.5 kg K_2O ha^{-1} (KCl)); B3 (Organic fertilizers/cow manure 10 t ha^{-1}) and B4 (Organic fertilizers/cow manure 5 t ha^{-1}).

CONCLUSION

Based on the growth and yield of shallot var. Philippines, it can be concluded that the growth of shallot var. Philippines planted in Batu were varied, i.e. plant height from 45.9 – 53.6 cm; leaves number 43.4 – 58.7 sheets/hill; leaf area per each leaf 27.8 – 36.1 cm^2 and leaf area index 2.43 – 4.39. Application Biourine combined with inorganic fertlilizers had resulted higher yield at 3.2, 10.9, 12.9 and 28.1% respectively than without Biourine. Shallot var. Philippines planted in Batu resulted varied yield also, i.e. treatment without Biourine which was fertilized with inorganic fertilizers: 50 kg N ha^{-1} (ZA), 25 kg P_2O_5 ha^{-1} (SP36) and 37.5 kg K_2O ha^{-1} (KCl), resulted bulb yield of 1,156.9 g m^{-2} (11.6 t ha^{-1}). Treatment Biourine and inorganic fertilizers: 100 kg N ha^{-1} (ZA), 50 kg P_2O_5 ha^{-1} (SP36) and 75 kg K_2O ha^{-1} (KCl), resulted bulb yield 1,860.2 g m^{-2} (18.6 t ha^{-1}) or increased 60.8%. Application Biourine combined with organic-inorganic fertilizer increased soil pH, decreased soil nutrients: %C (very low); %N (low), P_2O_5 (ppm) Olsen P_2O_5 (high) and K (me) As. Ac. pH 7.1 N_2O (high).

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